CAFTA-DR
Environmental Cooperation Program

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U.S. DEPARTMENT of STATE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

BATTELLE

LANDFILL CONSTRUCTION AND OPERATIONS WORKSHOP

LANDFILL CONSTRUCTION AND OPERATIONS WORKSHOP

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1	Importance of Proper Landfill Management	P. Ruesch
2	Landfill Construction Part I	M. Elizondo
3	Landfill Construction Part II	J. Davila
4	Landfill Operations Part I	M. Elizondo
5	Landfill Operations Part II	M. Elizondo
6	LFG Basics and GCCS	J. Davila
7	LFG Utilization Technologies	J. Davila
8	Open Dump Closure	P. Ruesch

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Module No. 2
Landfill Construction Part I

Marcos Elizondo, WCA

Purpose

- Technical guide explains minimum controls and testing needed during landfill construction
- Including:
  - Liner system
  - Leachate collection system
  - Groundwater monitoring wells
  - LFG monitoring probes

Landfill

Siting

- Location/siting restrictions
- Physical & social aspects
- Environmental impact assessment

Siting

- Physical conditions
  - Geology
  - Hydrogeology
  - Groundwater
  - Climate
  - Surface water (rivers, lakes, creeks)
  - Geological faults
  - Active seismic zones
  - Unstable zones
  - Endangered species

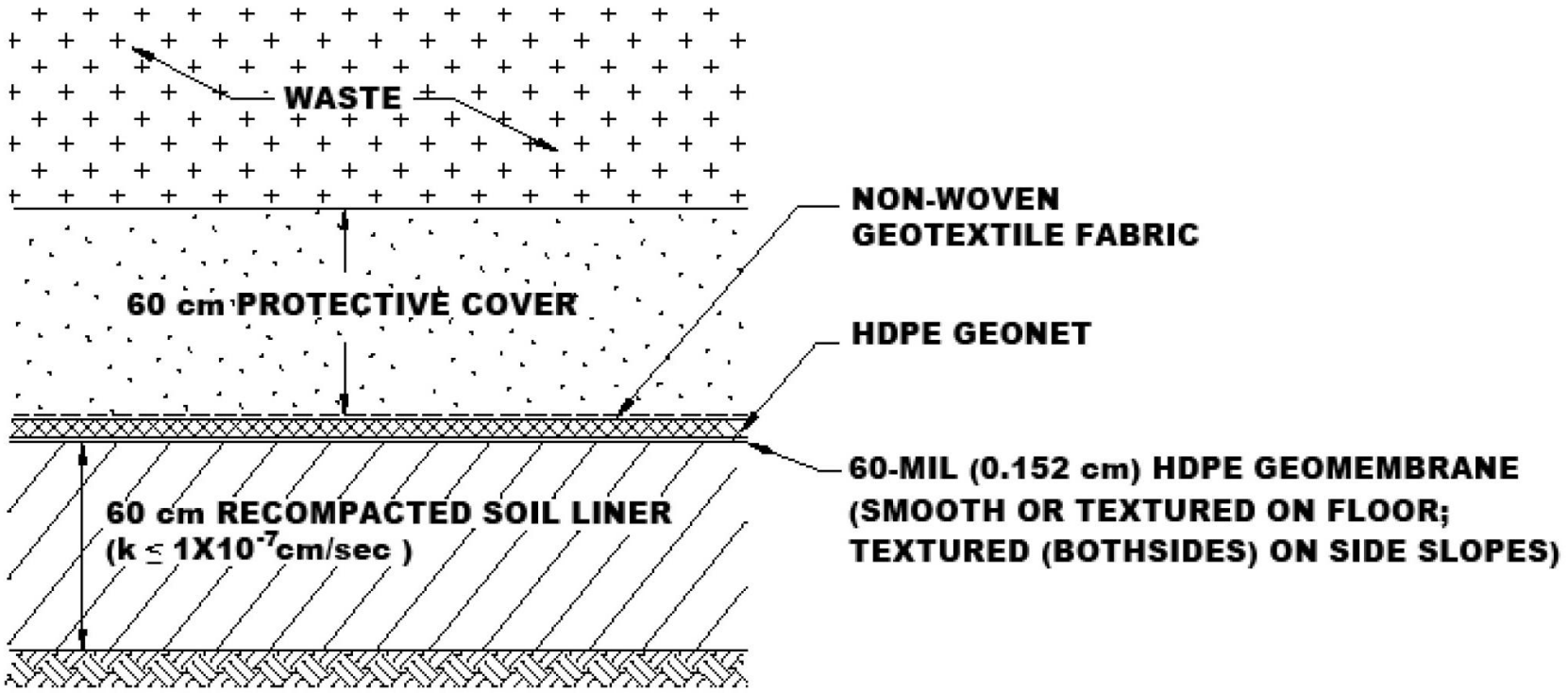
Siting

- Social Considerations
  - Schools or childcare facilities
  - Churches
  - Hospitals
  - Cemeteries
  - Commercial or residential developments
  - Recreational areas
  - Historic sites
  - Archeological sites
  - Sites with exceptional aesthetic quality
- Public, local government, and community involvement

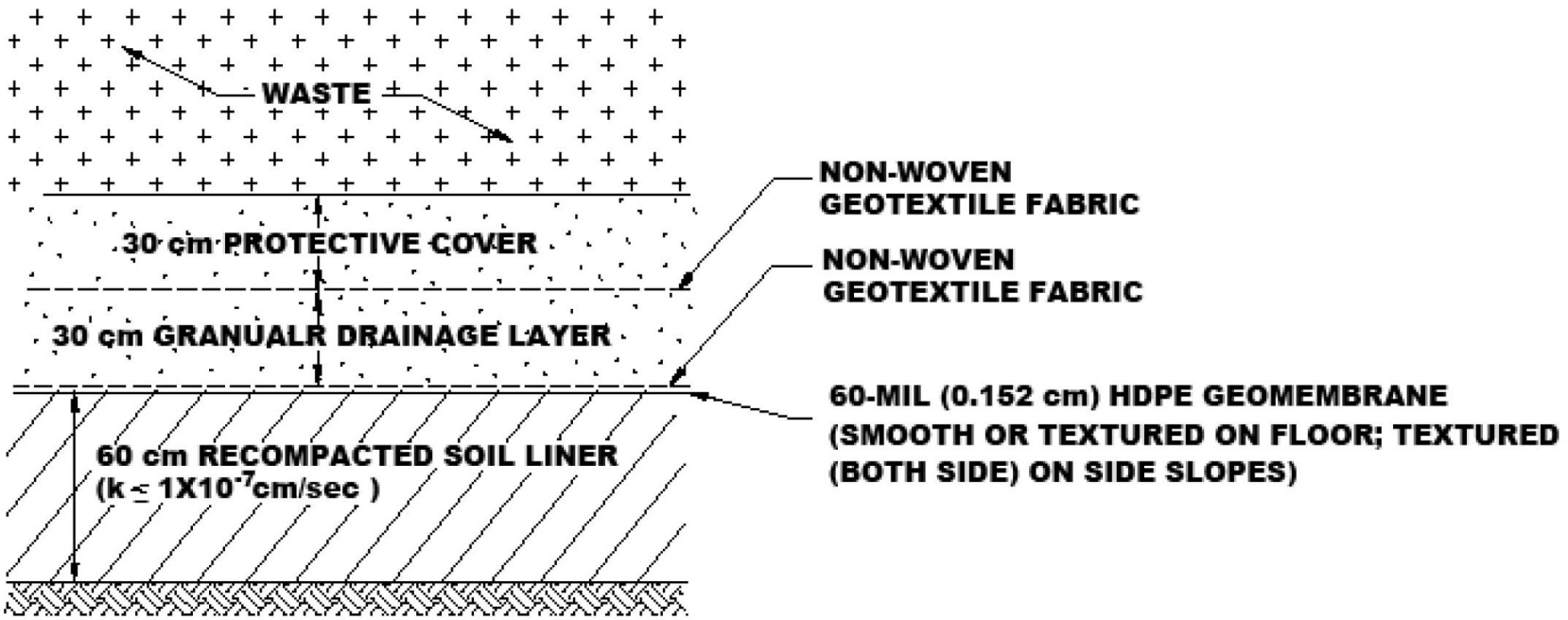
Cell Components

- Liner system
  - 60 cm compacted soil
  - k =1X10^{-7} cm/s
  - 60-mil (0.152 cm) HDPE geomembrane
  - Smooth or textured on flat surfaces
  - Textured (both sides) on slopes
- Leachate collection system

Liner Components



Liner Components



Leachate Collection System Components

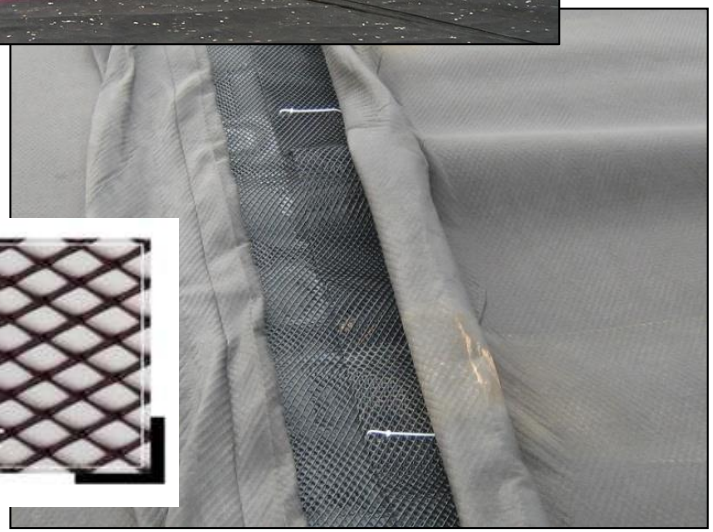
- Any liquid that goes through the waste turns into leachate
- Leachate tends to move downward to the bottom of the landfill
- Leachate is collected by the liner system
- The collection system transports leachate to the sumps
- The system is design to control the leachate levels on the liner system

Leachate Collection System Components

- Main components
  - Drainage layer
  - Collection pipe
  - Sumps
  - Risers and pump system
  - Leachate management

Leachate Collection System Components

- Drainage layer
  - Granular
    - Sand
    - Gravel
  - Geosynthetic
    - Geonet
    - Geotextile

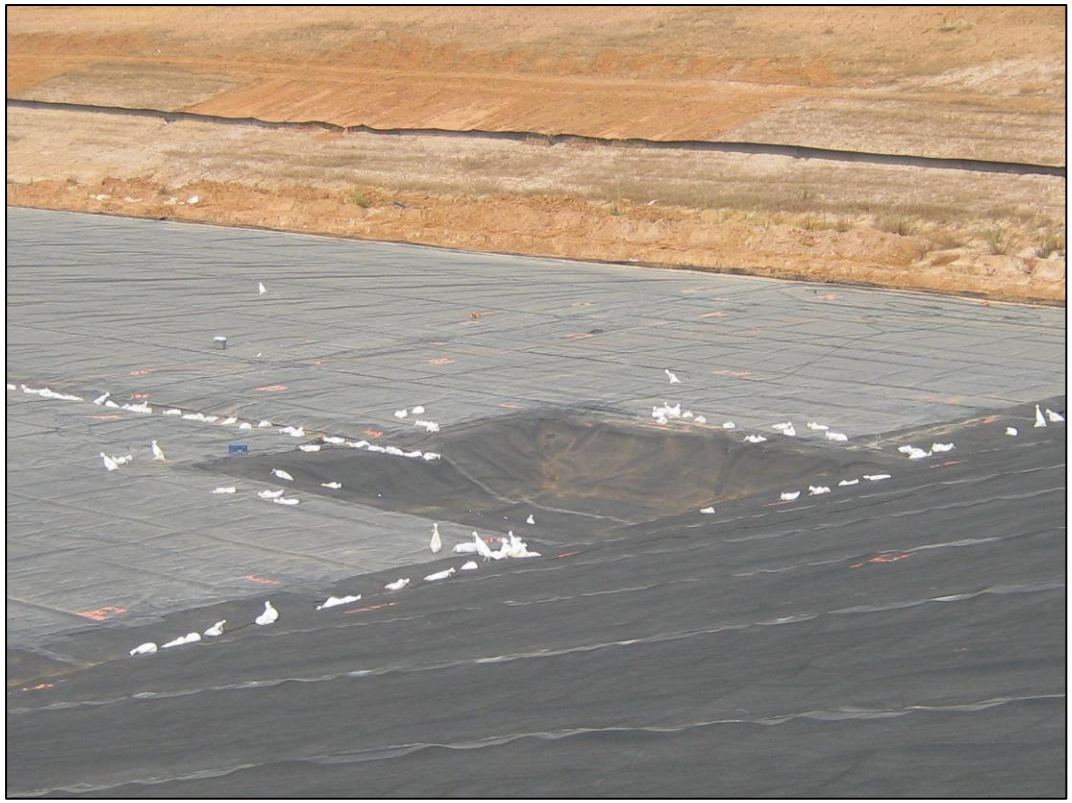


Leachate Collection System Components

- Collection pipe
  - PVC
  - High Density Polyethylene (HDPE)

Leachate Collection System Components

- Sump



Leachate Collection System Components

- Riser and pump system

Leachate Collection System Components

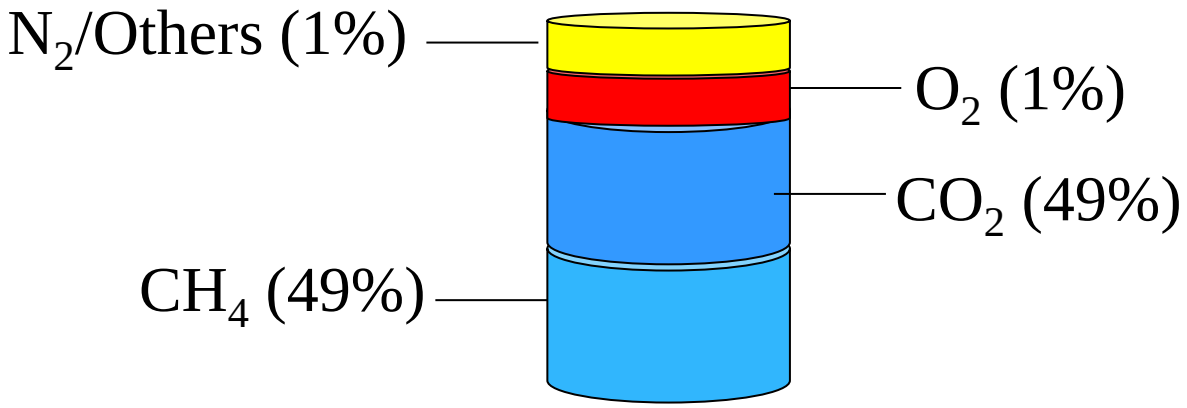
- Leachate management
  - Ponds
  - Tanks
  - On-site treatment
  - Off-site treatment

Construction Quality Control/ Assurance

- Quality Control/Assurance (QC/QA) includes: monitoring, testing, and recommendations during construction.
- Personnel must be familiarized with procedures, specifications and construction plans.
- Monitoring and documentation during all phases of the construction.
- Recommended for all landfill construction phases.

LFG

- LFG is generated by the anaerobic decomposition of organic waste.
- Composition is ~ 50% methane, 50% carbon dioxide, traces of other compounds.



LFG

- Safety
  - Odors
  - Explosions
  - Greenhouse gases

LFG

- Perimeter monitoring system
  - Monitoring probes
  - Typically monitored quarterly
  - Danger at 5% methane by volume

LFG

- Control systems
  - Passive
    - Vent wells
    - Individual flares
  - Active
    - Flares

Bottom Liner Construction

- 60 cm soil layer
- Permeability < 1 x 10^{-7} cm/s
- Liquid Limit > 30
- Plasticity Index > 15
- % of material passing 0.075 mm sieve > 30%
- Maximum rock size = 25 cm
- Rock or stone content < 10%

Bottom Liner Construction

- In-situ soils can be used if specifications are met
  - 1 test every 5,000 m^2
  - Thickness check 1 every 500 m^2

Bottom Liner Construction

- Stormwater system constructed to remove water around bottom liner system
- Minimize flow of water towards/on bottom liner
- Stormwater must be removed from bottom liner system as soon as possible
- If water can't drain by gravity, use pumps

Bottom Liner Construction

- Liner hydration
  - Very important
  - Required for compaction
  - Add water during mixing
  - Water must be clean (no leachate)

Bottom Liner Construction

- Lumps & rock size
  - Lumps must be reduced to obtain target permeability
  - No rocks or stones > than 25 mm

Bottom Liner Construction

- Soil compaction

Bottom Liner Construction

- Protective soil layer
  - 60 cm minimum between geomembrane and waste
  - 30 cm minimum between leachate collection system and waste
  - Must permit leachate to flow to drainage layer
  - Permeability must be > 1×10^{-4} cm/s, or provide ways to remove leachate through other soils or piping

Bottom Liner Construction

- Protective soil layer

Bottom Liner Construction

- Quality assurance testing
- Field Density
  - Nuclear gauge (~ $8,000)
  - Manual test equipment (~ $200)

Geomembrane Liner

- Geomembrane – High Density Polyethylene flexible liner
  - Thickness 60 mils (0.152 cm)
  - Liner installed over soil

Bottom Liner Construction

- Fabricated with raw materials
- Delivered in rolls
- Inspected for signs of damages or defects when received
- Protect from soft humid, rocky or uneven grounds
- Do not store stacked more than 5 rolls high

Bottom Liner Construction

- Base preparation

Bottom Liner Construction

- Geomembrane installation
  - Avoid damage to base and geomembrane

Bottom Liner Construction

- Geomembrane installation
  - Do not install during inclement weather
    - Rain
    - High winds
  - During high winds, stop construction and secure geomembrane to base using tires, extra rolls of material, sand bags or other heavy material that will not damage the geomembrane

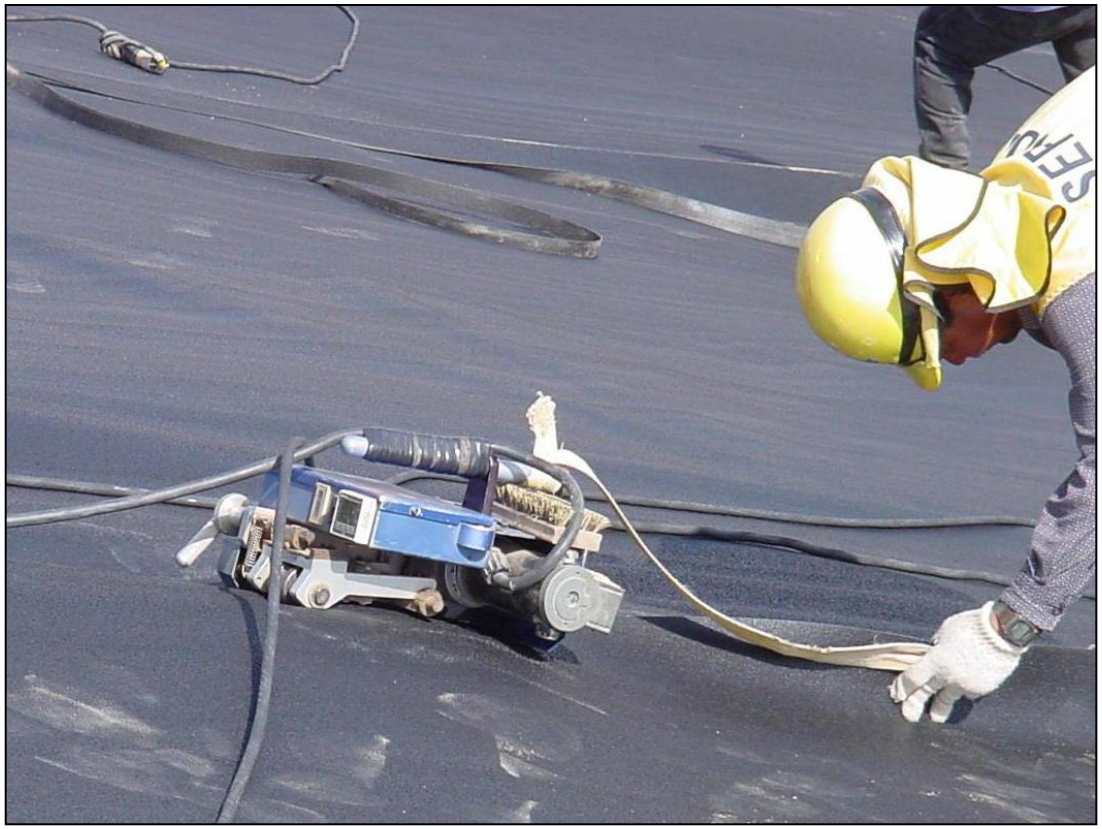
Bottom Liner Construction

Bottom Liner Construction

- Equipment
  - Use only low-ground pressure (LGP) equipment such as:
    - Golf carts
    - Small four-wheelers
    - Other equipment with rubber tires floor pressure < 35 kPa and a total weight = 340 kg (including load)

Bottom Liner Construction

- Fusion welding

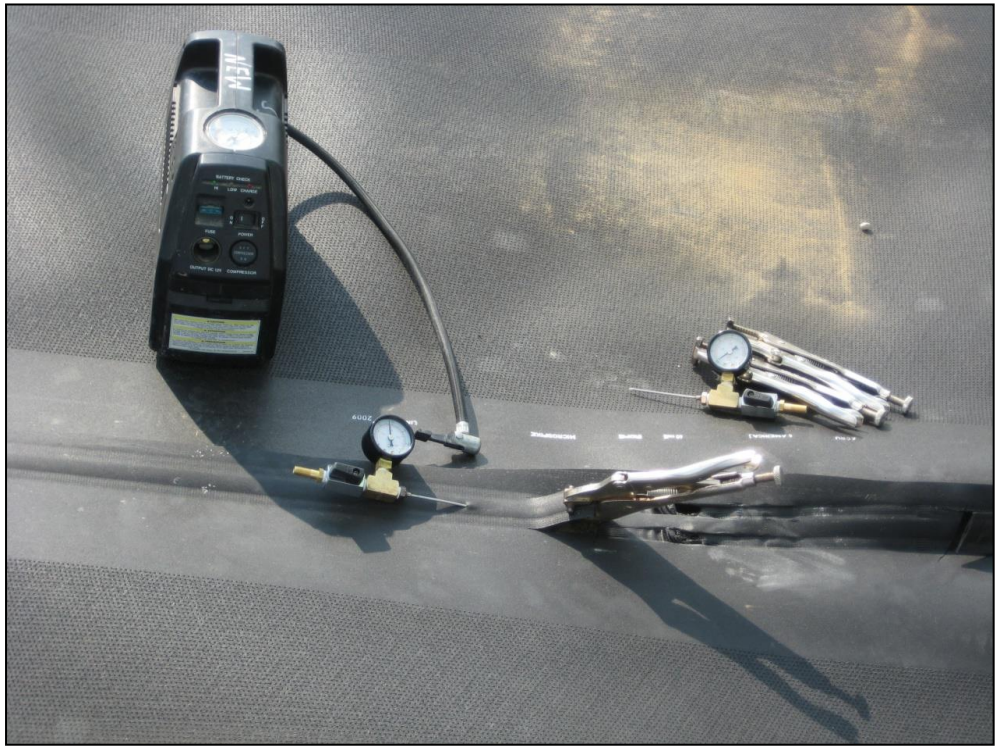


Bottom Liner Construction

- Extrusion welding

Bottom Liner Construction

- Pressure test for fusion welding



Bottom Liner Construction

- Suction test for extrusion welding

Bottom Liner Construction

- Destructive Testing at unions

Bottom Liner Construction

- Repairs and tests
  - Continuous visual inspections to detect holes, punctures, perforations, tears or breaks
  - Repairs must be done using welded patches
  - All repairs and unions must be tested

Bottom Liner Construction

- Anchor trench and fill material
  - Anchor trench must be located around all edges of the geomembrane which will not be used for future connections to next cell

Bottom Liner Construction

- Anchor trench and fill material
  - Anchor trench must be filled with compacted soil

Bottom Liner Construction

- Protective soil and drainage layer materials
  - Protective soil and drainage layer of 60 cm
  - Install during the cooler hours of the day
  - Install in fingers to control and minimize wrinkles
  - Install upwards on slopes
  - Install with light equipment such as a low ground pressure bulldozer
  - Continuous supervision during construction by a CQA professional is recommended

Bottom Liner Construction

- Protective layer and granular drainage

Bottom Liner Construction

- Protective soil layer installed in fingers

Thank You

Module No. 2
Landfill Construction Part I

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